



Lessons Learned Workshop for PI-Led Planetary Missions
11 April 2006

PI vs. Project Manager Lessons

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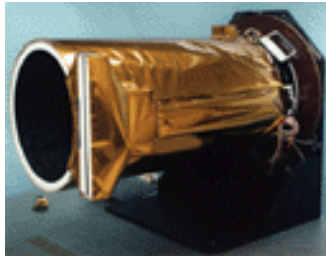
PI-led Missions

- PI-led, competed missions are good
 - Competition fosters cost-effectiveness
 - PI can help focus the effort on the ultimate goal, and
 - PI can provide a specific scientific vision (to provide a counterbalance to the consensus science of the “flagship” missions)



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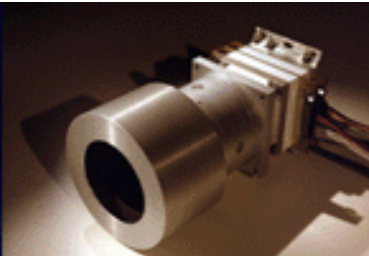
MSSS Cameras, Past and Present



Mars Orbiter Camera
Mars Global Surveyor



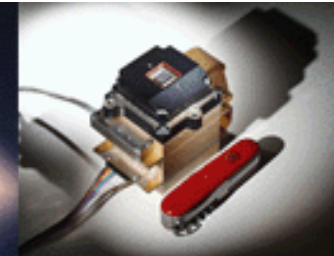
Mars Color Imager Wide Angle
Mars Climate Orbiter



Mars Color Imager Medium Angle
Mars Climate Orbiter



Mars Descent Imager
Mars Polar Lander



THEMIS Visible Imaging
Mars Odyssey



Context Camera
Mars Reconnaissance Orbiter



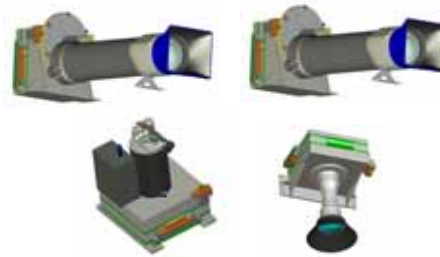
Mars Color Imager
Mars Reconnaissance Orbiter



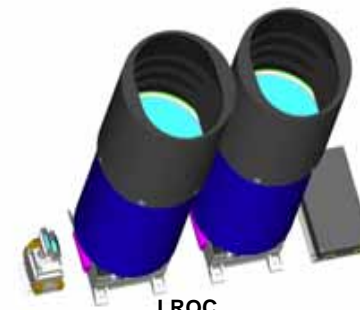
The Planetary Society Camera
Cosmos-1 Solar Sail



Mars Descent Imager
Mars Polar Lander



Mastcam & MAHLI and MARDI
Mars Science Laboratory



LROC
Lunar Reconnaissance Orbiter



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Background

- By experience and inclination, I straddle the engineering and science sides of the planetary business. MSSS does both, but with the mindset of scientists who became engineers and managers because they had to, rather than the other way around.
- I've been project manager or deputy project manager a number of flight imaging system development projects--not all of them had Mike Malin as PI.
- My big picture view of what we try to do is to extract the most science value we can out of the pretty substantial costs associated with doing planetary missions.



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PI vs. PM: What Works (1)

- Preferred situation: scientists are engaged and be informed about the technical details, and the managers and engineers have internalized some model of the science goals
- As a PM, what I look to the PI for is a vision of the investigation. What are we trying to do?
- Project management and engineering won't necessarily understand all the nuances of the science, but giving them a model of the vision is helpful because:
 - It informs tradeoffs they have to make that aren't even visible at the higher levels,
 - It motivates them--if they think it's worthwhile, there's a better effort.
- In return, I try to provide to the PI some idea as to the limits of the possible--technologically, cost-wise, schedule-wise, mission assurance-wise. The PI needs to have some model of THESE things, so he or she can participate in the process, especially where the management simplified model of the vision fails.



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PI vs. PM: What Works (2)

- Below the level of vision is the standard systems engineering yada yada yada--clear identification of requirements, understanding of constraints, and so forth. This part usually requires effort on my part, as that view of things doesn't come naturally to some people, which is can be an ongoing effort throughout the project--both to learn from the PI what is wanted, and to convey to the PI the limitations of the system.
- Regarding limitations: designs that use TDI (time delay integration) to increase effective exposure time are easier to build if then only have to work in one scan direction. Since we have a camera flying around Mars right now that's flying in the opposite direction from what it was designed for, this could be an issue. So, every time we've propose such a camera, we made sure to ask (over and over) if they wanted to spend the extra \$500K it would take to make the camera scan in both directions. For one mission, that was acceptable, for another, it wasn't.



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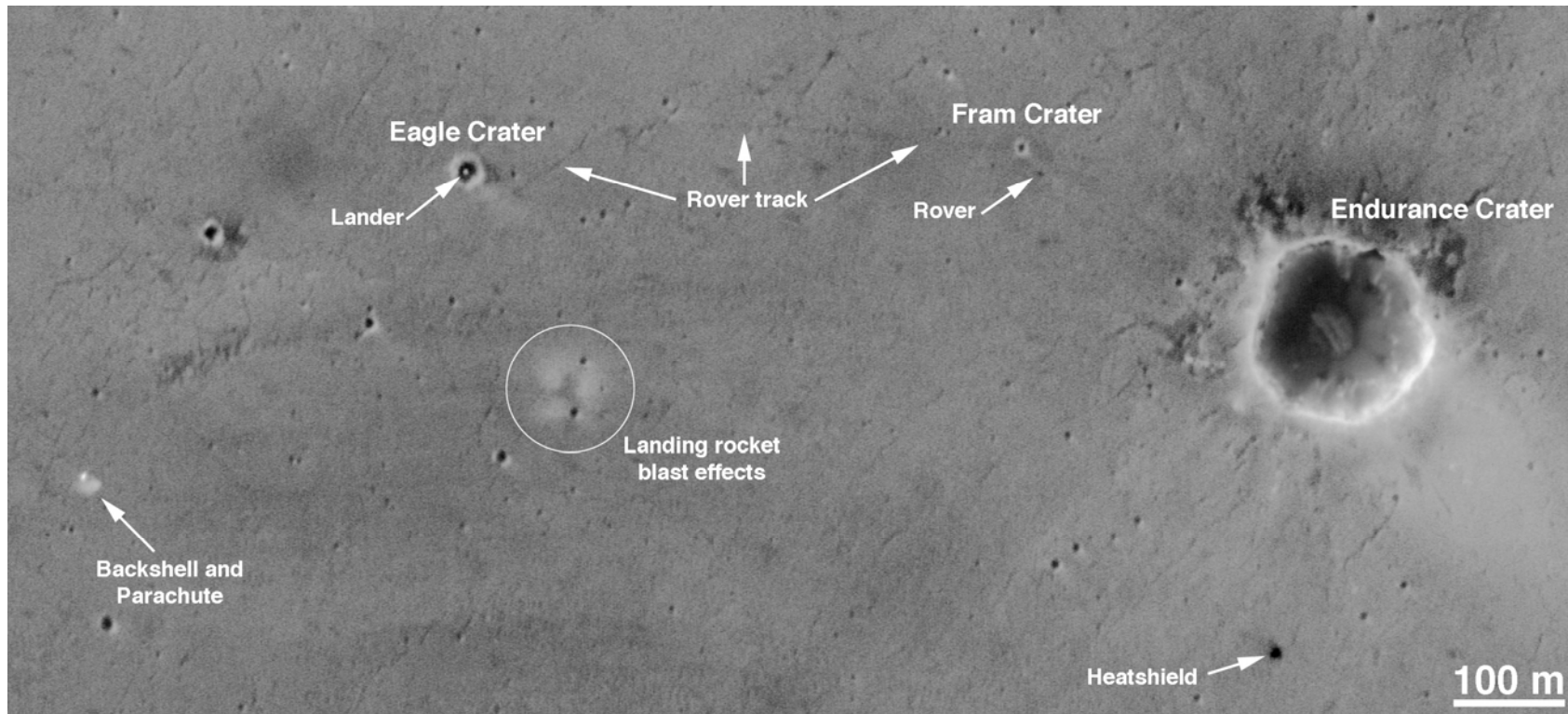
What Worked: MOC NA

- Mike Malin elucidated a very clear motivation for the resolution of the Mars Observer Camera (MOC) narrow angle (NA) system: an order of magnitude increase in resolution is necessary to yield new discoveries
 - Plausible *a priori* (consider Mariner 9 vs. Viking)
 - After the fact, with a hundred thousand MOC NA images in hand, it's turned out to have been right.
- From a management standpoint, it was a clear, unambiguous motivation. Everyone on the team, down to the receptionist, understood that we were building a camera to get 1.5 m per pixel resolution of Mars.
 - It drove us to push on the state of the art pretty hard in some parts of the design,
 - It certainly motivated the individual members of the team, the idea that we were doing something that they understood the value of.



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Opportunity Landing Site

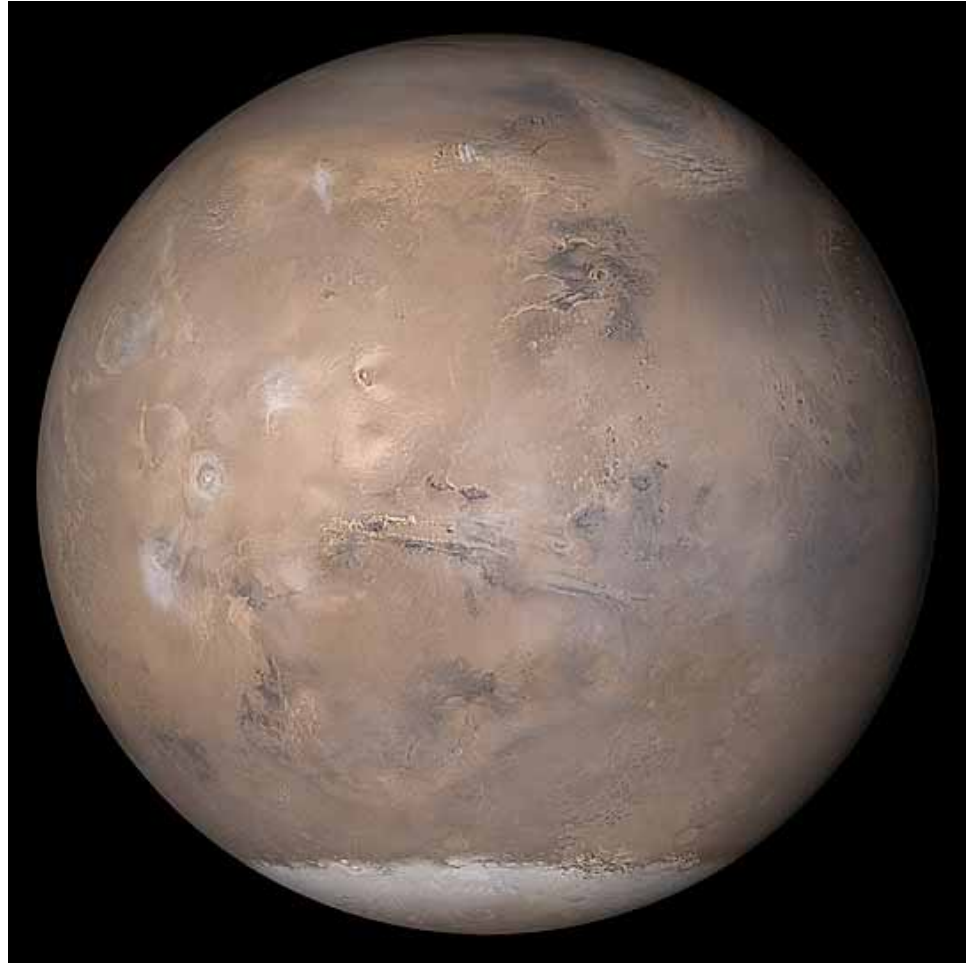




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What Worked: MOC WA Color

- The MOC wide angle camera needed color to distinguish dust and water ice clouds.
- Seriously considered descopeing color, but the motivation was so well understood that we chose not to.

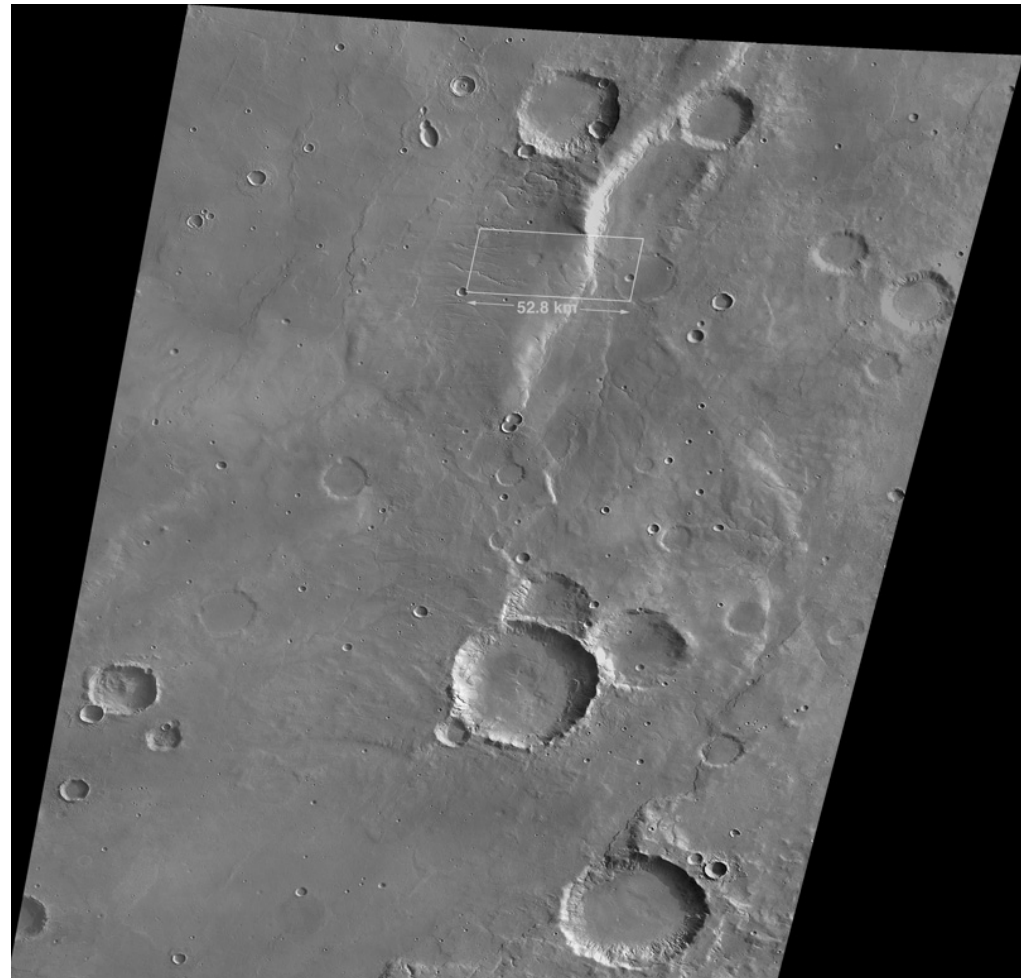




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What Worked: MRO CTX FOV

- The context camera (CTX) on MRO provides context imaging for the higher resolution instruments.
- Given five years of MOC NA targeting experience, the PI could clearly argue that a wide field was necessary to provide that context.
- This turned out to be a real challenge, but given the motivation, one that we chose to accept.





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What Worked Less Well: PI Involvement

- During the MOC development, the PI spent one day a week with the hardware team. From a PM standpoint, this turned out to have been perhaps the least optimal situation:
 - PI not around at all--you're on your own and you know it.
 - PI around all the time--PI is a member of the team, is up to speed and is part of the process of developing a consensus view of the project
 - PI around a day a week--knows enough to cause trouble, but not there long enough to help resolve it